BIFOCAL LENSES AND ANISOMETROPIA

BY

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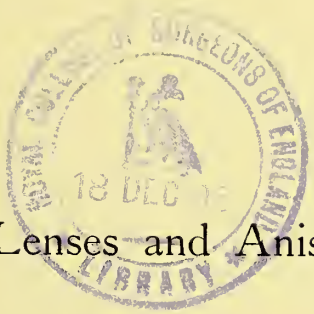

Bifocal Lenses and Anisometropia.

It is a matter of frequent experience in cases of anisometropia where simultaneous binocular vision is present that spectacles, arranged with the full refractive correction for each eye, are not tolerable by the patient, or at best are only worn with a greater or less feeling of discomfort. In many cases the discomfort is no doubt due to the disturbance of balance between accommodation and convergence; but another and a simpler cause may be found in the difference of prismatic effect of the two lenses of the spectacles.

It is of the nature of a spherical lens that a ray of light passing through any part of it but the optical centre should be bent from its course in the same way that it would be bent if passing through a prism. It is evident that this

prismatic effect varies (1) as the strength of the lens, and (2) as the distance from the centre of the penetrating ray at the point of penetration. Ernest Clarke* gives 8.7 mm. as the distance from the centre at which a lens of 1D. gives a prismatic effect of 1°. From this, in order to measure the prismatic effect (P) of any given lens at any part of the lens, we can construct the formula:

$$P = \frac{d \times D}{8.7}$$

where d = distance from centre in millimeters and D = number of dioptres.

By means of this formula we find the prismatic effect of a sph.—6D. lens at a distance of 4.35 mm. from its centre to be 3°; and at a distance of 15 mm., P = 10°. Similarly in a — 3D. lens at a distance of 4.35 mm. P = 1½°, and at 15 mm. P = 5°. So that in a pair of spectacles fitted with glasses

R. sph.—6 D.
L. sph.—3 D.

there is a difference of prismatic effect ranging from 0 at the centres of the lenses to 5° or more at their margins; or in other words, if the patient look through his spectacles at a point 5 mm. from the centres he has to correct a displacement of the images equivalent to that caused by a prism of 1½° held before one eye, and, if he look down through the

* "Eyestrain," p. 140.

ower margin of the glasses, the difference of displacement is equal to a prism of 5°, base down. Evidently with such or similar spectacles, vision is only easy through the centres of the lenses and the parts immediately surrounding them ; as the distance of the line of sight from the centres of the two lenses increases, the difference of prismatic effect will also increase, and a greater muscular effort will be necessary to obtain fusion of the two images ; at a certain point fusion is no longer possible and two clear separate images result. Even if this last stage is not reached, the irregular and varying efforts necessary to obtain fusion are most likely to induce asthenopia, and are quite sufficient to explain the patient's dislike of the spectacles.

The following table gives the equivalent prismatic effect for several dioptric differences between the two lenses at varying distances from the centres. A fair-sized round-oval spectacle-eye measures 40 × 35 mm.

TABLE OF PRISMATIC DIFFERENCES.

Difference between lenses.	Distance from Centre.	5 mm.	10 mm.	15 mm.	20 mm.
	.5D.	.3°	.5°	.8°	1.1°
	1D.	.5°	1.1°	1.7°	2.3°
	2D.	1.1°	2.3°	3.4°	4.6°
	3D.	1.7°	3.4°	5.1°	6.9°
	4D.	2.3°	4.6°	6.9°	9.2°
	5D.	2.8°	5.6°	8.6°	11.5°

Spectacles for anisometropia must always be a compromise. They may be fitted with the full correction for both eyes, and so subject the patient to the muscular effort indicated. Or both lenses may be worked to the power of the weaker eye in myopia, or the stronger in hyperopia; such spectacles at any rate would avoid strain; but in cases where the habit exists of binocular vision, the combination of the clear and the blurred image cannot be comfortable; and it would seem best to give both eyes the full correction, but *so to limit the size of one lens that the difference in prismatic effect of the extreme margin of the lens and of the corresponding part of the other lens does not exceed what can be corrected without undue effort.*

This effect can be best gained by means of the "Bifocal lens," which consists of two lenses worked concentrically on one glass; the inner one to the right refractive correction of the eye before which it is placed, and the outer one to the right correction of the *other eye.*

With spectacles so arranged, each eye being fully corrected, through the central and effective part of the lenses easy binocular sight is attained; and if the sight be directed beyond the sphere of the inner lens there is no liability to strain, both images, though only one is clear, being superimposed.

The size of the inner lens will depend upon the difference between the two lenses, and also upon the limit of easy effort necessary to obtain fusion; this of

course varies in individuals and each case must be judged by its own conditions, but it would not seem advisable to exceed a difference of prismatic effect of 2°, and in some cases no doubt a closer limit would be not only desirable, but necessary.

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